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Immature stages of workers of *Ectatomma edentatum* Roger, 1863 (Hymenoptera, Formicidae)

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ABSTRACT: The morphology of the immature stages (eggs, larvae and pupae) of the Ponerine ant *Ectatomma edentatum* Roger, 1863 is described. Larvae had three instars during the post-embryonic period of development, without evident morphological differences except for the width of the cephalic capsules. The mandibles have a tooth in the three instars. Hairs are present since the first instar, uniformly distributed on the larval body, and did not vary in length in the three instars.

Key words: eggs, larval instar, pupae, *Ectatomma*, Ponerinae

INTRODUCTION

Adult ants of the family Ponerinae are morphologically characterized by the presence of fusion between the tergal and sternal plates in the fourth abdominal segment and by the presence of large presclerites in this same segment, although this last character is apparently convergent in Cerapachyinae and Myrmeciinae (BARONI-URBANI *et al.,* 1992). Generalized profile of the Ponerinae larvae have an elongated thorax and a portion of the abdomen and their neck is ventrally folded, with

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the remaining part of the ventral portion being straight and the dorsal portion being convex and rounded in the caudal region. The body profile of the larvae varies little between species of the same genus, but the heterogeneity of traits among genera makes it difficult to characterize the subfamily on the basis of larval morphology. The pupae are usually covered with a cocoon (WHEELER & WHEELER, 1979).

The period between ovipositing and adult emergence is only a small fraction of an ant's life and it is highly dependent on temperature (HÖLLDOBLER & WILSON, 1990). Distinction and description of larval instars frequently are a prerequisite for ecological investigations of social insects such as the study of colony development by the analysis of age distribution (MASUKO, 1990). The number of larval instars may vary from three to forty in insects, with three to six instars occurring in Hymenoptera (SEHNAL, 1985). The basic number of larval instars usually seems to be four in ants (HÖLLDOBLER & WILSON, 1990), ranging from three to six (MASUKO, 1990). Most of these studies were conducted on species belonging to two advanced subfamilies, Myrmicinae and Formicinae, with Ponerinae having been almost fully ignored in this respect (MASUKO, 1990).

The aim of the present paper was to described the morphology of immatures (eggs to pupae) and to determine the number of instars detected during the larval development of the ant *E. edentatum* (Hymenoptera, Formicidae, Ponerinae).

MATERIAL AND METHODS

We collected nine colonies of *E. edentatum* located in the Jardim América neighborhood, peripheral region of Rio Claro city, SP (22°24'36" S, 47°33'36" W, altitude 612m), Southeastern of Brazil. The subterranean nests were dug by the method described by ANTONIALLI-JUNIOR & GIANNOTTI (1997) and the immatures were fixed in Dietrich solution for 48 hours and preserved in 70% alcohol.

To characterize the immature stages we measured 52 eggs, 345 larvae and 67 pupae. The eggs (1 ocular unit was equal to 0.015mm) and pupae (1 ocular unit was equal to

0.031mm) were measured for length and diameter. For the determination of the number of instars, the larvae were measured for cephalic capsule width (1 ocular unit was equal to 0.180mm). All the stages were drawn under camera lucida: the body in lateral view and the head in frontal view. To confirm the empirical growth rule of Dyar, the mean widths of the cephalic capsules of the different larval groups were submitted to analysis by the Tukey test (PARRA & HADDAD, 1989), with the groups being considered as instars.

RESULTS AND DISCUSSION

Eggs

The egg is elongated and kidney shaped (Figure 1a), light brown in color when fecundated and whitish when not fecundated (trophic eggs). The mean length of the eggs is approximately 0.561 ± 0.046 mm and the mean diameter is 0.364 ± 0.022mm (n=52).

Larvae

The larvae are whitish in color, and it is similar to the most of Hymenoptera larvae. According to the classification proposed by WHEELER & WHEELER (1979), *E. edentatum* larvae present a pogonomyrmecoid profile (Figures 1.b, c, d) and their morphology is basically close to the general one for Ponerinae larvae described by WHEELER & WHEELER (1971). The larvae present numerous hairs or tubercles, usually large, strongly sclerotized mandibles of brown color (Figures 1.e, f, g), and 1 pair of teeth since 1st instar, without evident morphological changes during development.

Figure 1 - a- Egg; b, c, d- lateral view of 1st, 2nd and 3rd instar larvae; e, f, g- frontal view of the head of 1st, 2nd and 3rd instar larvae; h- frontal view of the head of a pupa;. i- lateral view of a pupa of *Ectatomma edentatum.*

Figure 2, which shows the frequency distribution of the cephalic capsule width of *E. edentatum* larvae, indicates the existence of three distinct peaks, suggesting the occurrence of three instars. According to PARRA & HADDAD (1989), the graphic of frequency distribution presents usually a distance between the groups of measurements of the cephalic capsules, with each grouping corresponding to a different instar. However, in *E. edentatum,* the frequency distribution was continuous, with no intervals in these measurements, so that the determination of the amplitude of variation and consequently of the means was not totally precise.

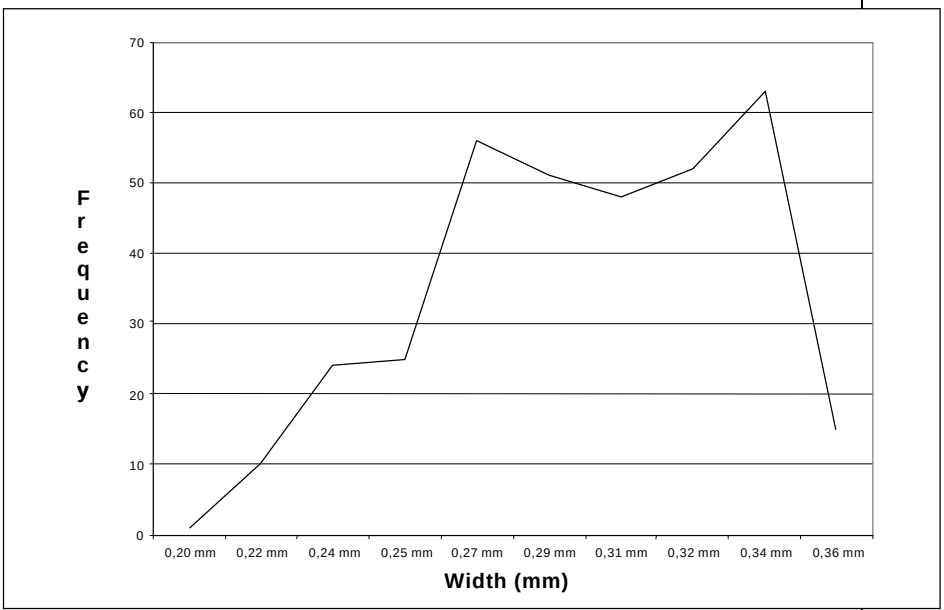

Figure 2 - Frequency distribution of the cephalic capsule widths (mm) of *Ectatomma edentatum* larvae.

Even so, we determined the mean widths of the cephalic capsule of each instar on the basis of the change in the slope of the frequency distribution curve (Figure 2), and the results are presented in Table 1. The Tukey test was applied to confirm that the means for the three groups were significantly different (Table 1). The growth rate of the cephalic capsules (Table 2) was 1.271 from the first to the second instar and 1.181 from the second to the third. Thus, the mean larval growth rate was 1.226,

a value distant from 1.400, which is the rate predicted by the rule of Dyar. Thus, we may conclude that this rule is not applicable to *E. edentatum*, although PARRA & HADDAD (1989) have stated that it is valid for Lepidoptera, Archeognatha, Hymenoptera, Coleoptera, Hemiptera and Homoptera. The determination of number of instars based on this rule has been widely utilized but has also been criticized because it does not apply to certain insect groups. SCHMIDT *et al*. (1977) criticized the method of cephalic capsule measurement for the determination of number of instars, stating that this method would only be applicable to those insects whose developmental rate covers a reasonably homogeneous number of instars, and that the use of the frequency distribution curve for the characterization of number of instars in a species or population in not always reliable.

Table 1 - Tukey test applied to the mean values for the three instars detected in *Ectatomma edentatum.* * = significant difference.

Instar	Mean (1)	Mean (2)	Mean (3)
	0.221	**0.281**	**0.332**
1	-	0.012070*	0.000519*
2	0.012070*	-	0.033682*
3	0.000519*	0.033682*	-

Table 2 - Mean cephalic capsule width (mm) of Ectatomma *edentatum larvae* and growth rate of larval instars.

Larval instars	Amplitude	Width (mm)		Growth	Mean
	(mm)	Mean	SD	rate	growth rate
1st instar	0.204-0.255	0.221	0.017		
2nd instar	0.272-0.306	0.281	0.012	1.271	1.226
3rd instar	0.323-0.357	0.332	0.012	1.181	

Table 3 - Number of larval instars in ants. Q, queen; M, male; S, soldier; W, worker.

Ant species	Adult category	N° of instars	References
Ponerinae			
Amblyopone silvestrii	QMW	5	[1]
Brachyponera chinensis	W	4	[1]
Odontomachus haematodes	QW	4	COLOMBEL 1978
Myrmicinae			
Aphaenogaster rudis	?	6 ? [2]	[1]
Acromyrmex octospinosus	QM	5	[1]
Acromyrmex octospinosus	W	4	[1]
Crematogaster stadelmanni	QW	3	[1]
C. striatula	QW	3	[1]
C. scutellaris	QMW	3	[1]
Messor aciculatus	W	3	[1]
Myrmica rubra (=ruginodis)	W	3	[1]
M. schrencki	W	4 ? [2]	[1]
Monomorium pharaonis	QMW	3	[1]
Pheidole bicarinata	QSW	4	[1]
P. fervida	QSW	3	[1]
P. pallidula	SW	3	[1]
Solenopsis invicta	QMW	4	[1]
Tetramorium caespitum	W	3	[1]
Ecitoninae			
Eciton burchelli	W	5	WHEELER & WHEELER 1986
Eciton hamatum	W		[1]
Formicinae			
Acantholepis frauenfeldi	W	5	[1]
A. syriaca	W	5	[1]
Catagyphis cursor	QMW	3	[1]
Camponotus aethiops	Q	6	[1]
	W	5	[1]
Camponotus aethiops	Q	6	DARTIGUES & PASSARELA 1979
Formica japonica	M	3	[1]
F. polyctena	QMW	4	[1]
Oecophylla longinoda	W	3 (or possibly 4)	WILSON & HÖLLDOBLER 1980
Plagiolepis pygmaea	W	5	[1]
Polyrhachis lamellidens	W	4	[1]

1 – Compiled from MASUKO (1990)

2 – Suggested but not confirmed by the authors.

According to Table 3, it can be seen that 13 ant species also present 3 larval instars, 7 species present 4 instars, 5 species present 7, and only 2 present 6.

Ectatomma edentatum larvae differ from *Solenopsis invicta* Buren, 1972 larvae, studied by PETRALIA & VINSON (1979), in terms of the presence of hairs, which are smooth and not branched, similar in this aspect to the hairs verified by MASUKO (1990) in *Amblyopone silvestrii* Wheeler, 1928. In *E. edentatum* larvae these hairs appear in uniformly large numbers since the 1st instar (Figure 2). Hair size also did not vary (0.25 mm) in the 3 instars. In *S. invicta* the 1st instar has no hairs, while hairs appear and gradually increase in number thereafter up to 4th instar.

Pupae

Ectatomma edentatum pupae (Figure 2 h, i) reach a mean length of 1.875 ± 0.049mm and a mean diameter of 0.729 ± 0.043mm and are protected by a brown silk cocoon which, according to WHEELER & WHEELER (1979) it makes possible the adult emergence without the help of workers.

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